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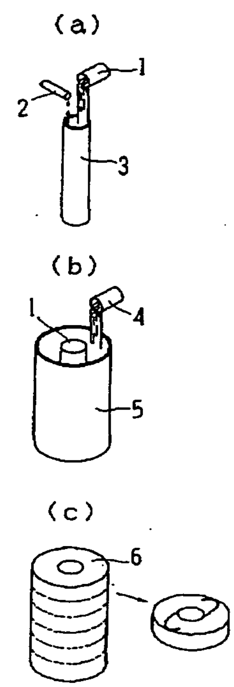
(54)【発明の名称】　眼内レンズの製造方法

(57)【要約】
【課題】　光学部と支持部の接合部分で強固な接合強度が得られ、折損の可能性を一層低減する。
【解決手段】　光学部と該光学部とは異なる材料からなる支持部とを一体形成する１ピースタイプの眼内レンズの製造方法において、前記光学部または支持部を得るためのいずれか一方の材料を先に重合硬化させる。その重合反応が終了する前の状態で、この重合部材に接するように他方の重合部材を配置して重合硬化させ、光学部と支持部の重合部材を複合した複合部材を得る。



【特許請求の範囲】

【請求項１】　光学部と該光学部とは異なる材料からなる支持部とを一体形成する１ピースタイプの眼内レンズの製造方法において、前記光学部または支持部を得るためのいずれか一方の材料を先に重合硬化させるとともに、その重合反応が終了する前の状態の第１の重合部材を得る第１プロセスと、該第１プロセスにより得られた第１の重合部材に接するようにもう片方の材料を配置する第２プロセスと、該第２プロセスにより配置した材料を重合硬化させることにより第１の重合部材と複合した第２の重合部材を得る第３プロセスと、を有することを特徴とする眼内レンズの製造方法。

【請求項２】　請求項１の眼内レンズの製造方法において、前記第３プロセスにおいては重合開始剤を用いないようにしたことを特徴とする眼内レンズの製造方法。

【請求項３】　請求項１の眼内レンズの製造方法において、前記第１プロセスにおいては重合開始剤を添加して重合を促進するステップを含み、重合反応が終了する前の状態とは前記重合開始剤を添加することにより発生するラジカルが重合部材に存在する状態であることを特徴とする眼内レンズの製造方法。

【請求項４】　請求項１の眼内レンズの製造方法において、重合反応が終了する前の状態とは第１の重合部材がほぼ硬化し、収縮過程に至る前であることを特徴とする眼内レンズの製造方法。

【請求項５】　請求項１の眼内レンズの製造方法において、前記第１プロセスでは光学部とするための材料により円柱形状の重合部材を形成し、前記第２プロセスでは該円柱形状の重合部材の外周側面に接するように支持部とするための材料を配置することを特徴とする眼内レンズの製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、白内障等により摘出された水晶体の代わりに眼内に挿入される眼内レンズの製造方法に関する。

【０００２】

【従来の技術】白内障により混濁した水晶体を摘出した後、水晶体の代わりに眼内に挿入する眼内レンズが知られている。眼内レンズは、その製造方法により３ピースタイプと１ピースタイプに大別される。

【０００３】３ピースタイプの眼内レンズは、レンズパワーを持つ光学部とこの光学部を眼内において保持するための支持部とを別々に形成し、その後の工程で１つに結合させることにより製造する。対して、１ピースタイプの眼内レンズは、一体化した材料部材を切削加工することによって光学部と支持部を形成する。

【０００４】最近では、小切開創からの挿入を行うことができる折り畳み可能なソフト眼内レンズが出現している。この眼内レンズにおいても光学部と支持部で異なる材料、すなわち、光学部は折り畳み可能な柔軟性材料を、支持部には眼内安定性のために比較的剛直な材料を使用して一体化させて形成する１ピースタイプの眼内レンズが提案されている。このようタイプの眼内レンズは、次のような方法により製作されている。まず、光学部または支持部となるいずれか一方の材料を先に重合硬化させた後に、もう片方の材料を先のものに接するようにして重合硬化させ、異なる材料の複合部材を形成する。この際、光学部及び支持部の材料を別々に重合硬化させる必要があるため、それぞれの材料に重合開始剤を添加して重合開始のきっかけを与えるようにしている。複合部材が形成できたら切削加工して光学部と支持部とを持つ眼内レンズを得る。

【０００５】

【発明が解決しようとする課題】しかしながら、上記のように光学部及び支持部のそれぞれの材料に重合開始剤を添加して重合を行うと、後の方で硬化させる材料は、先に重合硬化されたものと十分に相互作用することなく単独で重合硬化してしまい、両者の物理的な結合が充分に行われなくなってしまう。このため、光学部材と支持部材との接合部分での接合強度が、その他の部分に比べて弱くなる傾向にあった。この接合部分は眼内への挿入時や眼内での位置調整時に最も力が加わるところであり、接合強度よりも強い力が加わると折損してしまう可能性がある。眼内で折損があると、折損した支持部及び光学部は眼内から取り出し、新たに眼内レンズを挿入し直さなければならず、患者眼に負担がかかる。

【０００６】本発明は、上記問題点を鑑み、光学部と支持部とが異なる材料からなる１ピースタイプの眼内レンズにおいて、光学部と支持部の接合部分での接合強度を強くし、折損の可能性を一層低減することができる眼内レンズの製造方法を提供することを技術課題とする。

【０００７】

【課題を解決するための手段】本発明は上記課題を解決するために、以下のような構成を備えることを特徴とする。

【０００８】（１）　光学部と該光学部とは異なる材料からなる支持部とを一体形成する１ピースタイプの眼内レンズの製造方法において、前記光学部または支持部を得るためのいずれか一方の材料を先に重合硬化させるとともに、その重合反応が終了する前の状態の第１の重合部材を得る第１プロセスと、該第１プロセスにより得られた第１の重合部材に接するようにもう片方の材料を配置する第２プロセスと、該第２プロセスにより配置した材料を重合硬化させることにより第１の重合部材と複合した第２の重合部材を得る第３プロセスと、を有することを特徴とする。

【０００９】（２）　（１）の眼内レンズの製造方法において、前記第３プロセスにおいては重合開始剤を用いないようにしたことを特徴とする。

【0010】（3）　（1）の眼内レンズの製造方法において、前記第1プロセスにおいては重合開始剤を添加して重合を促進するステップを含み、重合反応が終了する前の状態とは前記重合開始剤を添加することにより発生するラジカルが重合部材に存在する状態であることを特徴とする。

【0011】（4）　（1）の眼内レンズの製造方法において、重合反応が終了する前の状態とは第1の重合部材がほぼ硬化し、収縮過程に至る前であることを特徴とする。

【0012】（5）　（1）の眼内レンズの製造方法において、前記第1プロセスでは光学部とするための材料により円柱形状の重合部材を形成し、前記第2プロセスでは該円柱形状の重合部材の外周側面に接するように支持部とするための材料を配置することを特徴とする。

【0013】

【実施例】本発明の一実施例を図面に基づいて以下に説明する。図1は一般的な1ピースタイプの眼内レンズを示す平面図である。30は屈折力を持つ光学部、31は光学部30を眼内で保持させるための支持部であり、光学部30とは異なる材料により形成されて可撓性を持つ。

【0014】次に、この眼内レンズの製造方法の一例について説明する。まず、図2（ａ）に示すように、円筒形反応容器3に光学部30を形成するための液体状の光学部材1を流入する。光学部材1の材料としては、アクリル酸エステルやメタクリル酸エステルが使用される。例えば、ポリメチルメタクリレート（ＰＭＭＡ）やエチルメタクリレート（ＥＭＡ）に代表される種々の剛直性材料、ヒドロキシエチルメタクリレート（ＨＥＭＡ）に代表される種々の親水性柔軟材料、さらに、これらの剛直性材料及び親水性柔軟材料であるアクリル酸エステルやメタクリル酸エステルを共重合させた共重合物等である。柔軟性がある材料を使用すると、折り畳み可能なソフト眼内レンズを得ることができる。

【0015】また、これらの材料にエチレングリコールジメタクリレート（ＥＧＤＭＡ）に代表される架橋材を添加してもよい。

【0016】なお、反応容器3の直径は、製品とする眼内レンズの光学部の直径と少なくとも同じか、それよりも大きいものを使用する。

【0017】続いて、反応容器3に流入した光学部材1には、重合開始のきっかけを与えるための重合開始剤2を少量添加する。重合開始剤2としては従来より多くのものが知られており、例えば、加熱重合の場合にはアゾビスイソブチロニトリル、アゾビスジメチルバレロニトリル等が、光重合の場合にはベンゾイン、メチルオルソベンゾイルベンゾエート等を使用することができる。

【0018】重合開始剤2を添加した後、加熱（あるいは光照射）して重合を開始させる。これにより、重合開始剤2は熱（あるいは光）によって分解してラジカル（遊離基）を生じるようになる。ラジカルを生じた重合開始剤2が光学部材1の分子と衝突すると、重合開始剤2と光学部材1が結合する。重合開始剤2に存在していたラジカルは光学部材1との結合因子となって消滅し、その代わりに光学部材1にラジカルが生じる。その後は、ラジカルを持つ光学部材1の分子が、他の光学部材1の分子に衝突、結合を繰り返すことにより連鎖的にラジカルを生じ、重合硬化が進行していく。

【0019】ここで、重合時間を十分に長く取ると、発生したラジカル同志も結合して重合反応が終了し、光学部材1は完全に重合硬化してラジカルが存在しない状態になる。

【0020】そこで、本発明においては、光学部材1にラジカルが多数残っている状態、つまり、重合が完全に終了する前に次の工程（後述する支持部材4を光学部材1の側面で重合硬化する工程）へ移行する。このタイミングとしては、光学部材1がほぼ硬化し、収縮過程にいたる前が好ましい。例えば、光学部材1の材料としてＨＥＭＡとＥＭＡを比率８５：１５で共重合させるものを使用するときは、５０℃で４８時間、６０℃で２４時間、７０℃で２４時間の順で加熱を終了した状態で次の工程へ移行する。

【0021】ラジカルが多数残っている状態で重合硬化した円柱状の光学部材1が得られたら、図2（ｂ）に示すように、これを円筒形の反応容器5のほぼ中央に固定する。反応容器5の直径は眼内レンズの全長に比べて少なくとも同じか、それよりも大きいものを使用する。光学部材1を固定したら、光学部材1の周辺部に支持部31となる支持部材4を流入する。その材料としてはアクリル酸エステル及びメタクリル酸エステルが使用でき、その例としては、ＰＭＭＡ、ＥＭＡ等に代表される剛直材料や、これらの剛直材料に２－エチルヘキシルメタクリレート等の柔軟性を備えるものを共重合させた共重合物等である。

【0022】支持部材4を流入後、反応容器5に熱を加えて重合を開始させる。このときの重合に際しては、本実施例では重合開始剤を用いることなく、重合促進のために熱を加えるのみで重合硬化を行う。前述のように、光学部材1は重合が完全に終了していないので、その外周部分にはラジカルが多数残っている状態である。加熱により分子運動を激しくした支持部材4の分子は、光学部材1のラジカルに衝突することによって結合する。すなわち、支持部材4の重合に際しては、ラジカルを持つ光学部材1が重合開始剤の役目を果たし、その重合は光学部材1の外周部分のラジカルと支持部材4の結合から進行するようになる。さらに、ラジカルによる連鎖反応によって重合が進行していく。こうして支持部材4と先の光学部材1との複合部材が形成される。重合開始剤を添加していない場合は、連鎖反応は重合開始剤から生じ

るラジカルの影響を受けることなく起こるので、支持部材４は光学部材１と化学的に強固に結合しつつ重合硬化し、その接合部は重合開始剤を加えた場合に比べてより強くなる。

【００２３】なお、上記では接合強度をより強固なものとするために、支持部材４の重合硬化時には重合開始剤を添加しないものとしたが、眼内レンズの使用に必要な接合強度と製作時間、その他の重合条件等との関係により重合開始剤を添加するようにしても良い。

【００２４】このようにして光学部材１と支持部材４との複合部材が得られたら、図２（ｃ）に示すように、反応容器５から取り出した複合部材６を必要な厚さに切断する。その後、周知の切削加工を行ことにより、光学部３０及び支持部３１を有する眼内レンズを製作する。

【００２５】こうして得られた眼内レンズは、光学部３０と支持部３１との接合部の強度が増し、折損の可能性が低くなる。

【００２６】以上の製造方法では光学部材１側を先に重合硬化させたが、支持部材４の方を先に重合硬化させることにより複合部材６を得るようにしても良い。この製造方法を図３に基づいて説明する。

【００２７】図３（ａ）において、２つの円筒状容器からなる反応容器１３に支持部材１４を流入する。支持部材１４を流入した後、重合開始剤１２を少量添加する。重合開始剤１２を添加した後、加熱（あるいは光照射）を行うことにより、重合開始剤１２は熱（あるいは光）により分解してラジカル（遊離基）を生じ、支持部材１４のラジカル重合が行われる。

【００２８】支持部材１４の重合反応が完全に終了する前に、支持部材１４内にラジカルが多数存在する固体化した状態で次の工程に移行する。

【００２９】図３（ｂ）において、図３（ａ）で形成した円筒状の支持部材１４を固定し、支持部材１４の中空部に光学部材１１を流入する。光学部材１１を流入後、熱を加えると重合が開始する。このとき、重合開始剤を加えずに加熱を行い重合を行う（必要な接合強度を確保しつつ重合時間を短くするときは、重合開始剤を添加する）。支持部材１４の内周部分にはラジカルが多数残っているので、そのラジカルにより支持部材１４の分子と光学部材１１の分子が結合するようになる。さらに、連鎖反応によって重合が進行し、接合部分の接合強度は強固なものとなる。

【００３０】こうして支持部材１４と光学部材１１とが接合して硬化した複合部材１６が得られたら、前述と同様に必要な厚さに切断した後、切削加工を施して眼内レンズを製作する。

【００３１】本発明は、上述したものに限定されるものではなく、種々の変容が可能であり、技術思想を同じくする範囲においては本発明に包含される。

【００３２】

【発明の効果】上述したように、本発明によれば、光学部と支持部の接合部分で強固な接合強度が得られ、折損の可能性を一層低減することができる。

【図面の簡単な説明】

【図１】眼内レンズの形状を説明する図である。

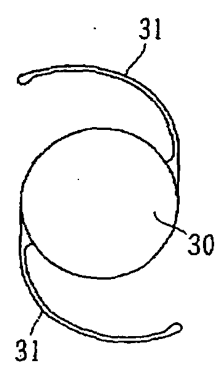
【図２】本実施例である眼内レンズの製造方法の一例を説明する図である。

【図３】本実施例である眼内レンズの製造方法の変容例を説明する図である。

【符号の説明】

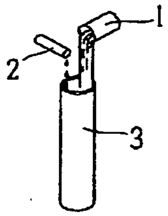
１、１１　光学部材
２、１２　重合開始剤
４、１４　支持部材
６、１６　複合材料
３０　光学部
３１　支持部

【図１】

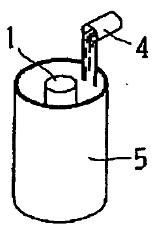


【図2】

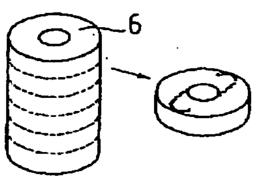
(a)



(b)

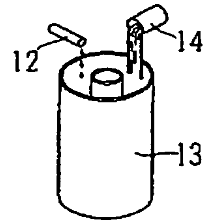


(c)



【図3】

(a)



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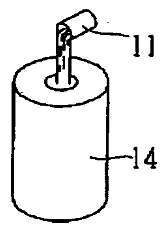
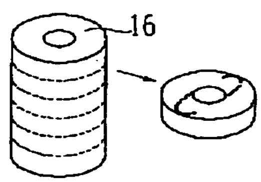


(c)



PRODUCTION OF INTRAOCULAR LENS

Patent Number:	JP10192311
Publication date:	1998-07-28
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Applicant(s):	NIDEK CO LTD
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Equivalents:	

Abstract

PROBLEM TO BE SOLVED: To improve the joint strength of the optical part and supporting part of a one-piece type intraocular lens and to prevent the failure thereof by subjecting a material for either of the optical part or supporting part to polymn. curing first, arranging the other material before the end of this polymn. curing and subjecting this material to polymn. curing, thereby combining and curing both materials.
SOLUTION: The liquid optical member 1 for molding the optical part is admitted into a cylindrical reaction vessel 3. Acrylate, etc., are used as the material. A small amt. of a polymn. initiator 2 is added to the materials and the polymn. is initiated by heating or photoirradiation. The columnar optical member 1 with which the polymn. is not completed yet is set in approximately the center of the cylindrical reaction vessel 5 before the completion of the polymn. The supporting member 4 for the supporting part, such as acrylate, is admitted into the peripheral part of the optical member 1. The member is then polymerized by heating the reaction vessel 5. In such a case, the polymn. initiator is not used. As a result, the unpolymerized radicals of the optical member 1 and the supporting member 2 are bound and the contact parts of both form the strong composite material. The strength is thus improved.

PATENT ABSTRACTS OF JAPAN

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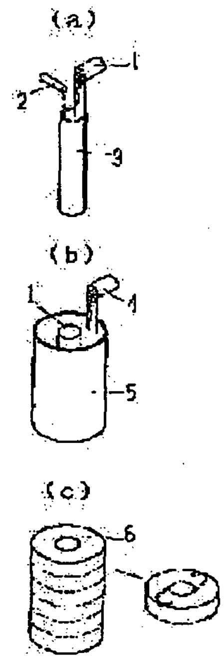
(54) PRODUCTION OF INTRAOCULAR LENS

(57)Abstract:
PROBLEM TO BE SOLVED: To improve the joint strength of the optical part and supporting part of a one-piece type intraocular lens and to prevent the failure thereof by subjecting a material for either of the optical part or supporting part to polymn. curing first, arranging the other material before the end of this polymn. curing and subjecting this material to polymn. curing, thereby combining and curing both materials.
SOLUTION: The liquid optical member 1 for molding the optical part is admitted into a cylindrical reaction vessel 3. Acrylate, etc., are used as the material. A small amt. of a polymn. initiator 2 is added to the materials and the polymn. is initiated by heating or photoirradiation. The columnar optical member 1 with which the polymn. is not completed yet is set in approximately the center of the cylindrical reaction vessel 5 before the completion of the polymn. The supporting member 4 for the supporting part, such as acrylate, is admitted into the peripheral part of the optical member 1. The member is then polymerized by heating the reaction vessel 5. In such a case, the polymn. initiator is not used. As a result, the unpolymerized radicals of the optical member 1 and the supporting member 2 are bound and the contact parts of both form the strong composite material. The strength is thus improved.



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CLAIMS

[Claim(s)]

[Claim 1] The manufacture method of the intraocular implant of 1 piece type which really forms the supporter which consists of a different material from an optical department and this optical department characterized by providing the following. The 1st process which obtains the 1st polymerization member of the state before the polymerization reaction is completed while carrying out polymerization hardening of one for obtaining the aforementioned optical department or a supporter of the material previously. The 3rd process which obtains the 2nd polymerization member compounded with the 1st polymerization member by carrying out polymerization hardening of the material arranged according to the 2nd process which already arranges one of the two's material so that the 1st polymerization member obtained according to this 1st process may be touched, and this 2nd process.

[Claim 2] The manufacture method of the intraocular implant characterized by making it not use a polymerization initiator in the 3rd process of the above in the manufacture method of the intraocular implant of a claim 1.

[Claim 3] The manufacture method of the intraocular implant characterized by the state before polymerization reaction is completed being in the state where the radical generated by adding the aforementioned polymerization initiator exists in a polymerization member including the step which adds a polymerization initiator in the 1st process of the above, and promotes a polymerization in the manufacture method of the intraocular implant of a claim 1.

[Claim 4] The manufacture method of the intraocular implant characterized by the state before polymerization reaction is completed being before the 1st polymerization member's hardening mostly and resulting in contraction process in the manufacture method of the intraocular implant of a claim 1.

[Claim 5] the material for considering as an optical department in the 1st process of the above in the manufacture method of the intraocular implant of a claim 1 -- a cylindrical shape-like polymerization member -- forming -- the 2nd process of the above -- the polymerization of the shape of this cylindrical shape -- the manufacture method of the intraocular implant characterized by arranging the material for considering as a supporter so that the periphery side of a member may be touched

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the manufacture method of the intraocular implant inserted into an eye instead of the lens extracted by cataract etc.
[0002]
[Description of the Prior Art] After extracting the lens which became muddy by cataract, the intraocular implant inserted into an eye instead of a lens is known. An intraocular implant is divided roughly into 3 piece type and 1 piece type by the manufacture method.
[0003] A 3 piece type intraocular implant forms separately the supporter for holding an optical department with lens power, and this optical department in an eye, and manufactures it by making it combine with one at a subsequent process. Receiving, a 1 piece type intraocular implant forms an optical department and a supporter by carrying out cutting of the unified material member.
[0004] Recently, the foldable soft intraocular implant which can perform insertion from a small incision has appeared. The 1 piece type intraocular implant which is made to unite with a supporter material which is different also in this intraocular implant with an optical department and a supporter, i.e., the flexibility material which an optical department can fold up, using a comparatively upright material for the stability in an eye, and is formed is proposed. The such type intraocular implant is manufactured by the following methods. First, after carrying out polymerization hardening of one of the material used as an optical department or a supporter previously, already, as a previous thing is touched, polymerization hardening of one of the two's material is carried out, and the compound member of a different material is formed. Under the present circumstances, in order to carry out polymerization hardening of the material of an optical department and a supporter separately, a polymerization initiator is added into each material and it is made to give the cause of a polymerization start to it. If a compound member is formed, the intraocular implant which carries out cutting and has an optical department and a supporter is obtained.
[0005]
[Problem(s) to be Solved by the Invention] However, if a polymerization initiator is added into each material of an optical department and a supporter as mentioned above and a polymerization is performed, the material stiffened in the direction of back will carry out polymerization hardening independently, without fully interacting with that by which polymerization hardening was carried out previously, and both physical combination will no longer be performed fully. For this reason, the bonding strength for the joint of an optical member and supporter material suited the inclination which becomes weak compared with other portions. The amount of this joint may break, if are just going to add the force most at the time of insertion into an eye, and justification within an eye and the strong force joins it rather than a bonding strength. If there is breakage within an eye, the supporter and optical department which broke will be taken out from the inside of an eye, must newly reinsert an intraocular implant, and will require a burden for a patient eye.
[0006] In view of the above-mentioned trouble, this invention strengthens the bonding strength for the joint of an optical department and a supporter in the intraocular implant of 1 piece type which consists of material from which an optical department and a supporter differ, and makes it a technical technical problem to offer the manufacture method of the intraocular implant which can reduce the possibility of breakage further.
[0007]
[Means for Solving the Problem] In order that this invention may solve the above-mentioned technical problem, it is characterized by having the following composition.
[0008] (1) While carrying out polymerization hardening of one for obtaining the aforementioned optical department or a supporter of the material previously in the manufacture method of the intraocular implant of 1 piece type which really forms the supporter which consists of a different material from an optical department and this optical department The 1st process which obtains the 1st polymerization member of the state before the polymerization reaction is completed, It is characterized by having the 3rd process which obtains the 2nd polymerization member compounded with the 1st polymerization member by carrying out polymerization hardening of the material arranged according to the 2nd process which already arranges one of the two's material so that the 1st polymerization member obtained according to this 1st process may be touched, and this 2nd process.
[0009] (2) In the manufacture method of the intraocular implant of (1), it is characterized by making it not use a polymerization initiator in the 3rd process of the above.
[0010] (3) In the manufacture method of the intraocular implant of (1), it is characterized by the state before polymerization reaction is completed being in the state where the radical generated by adding the aforementioned polymerization initiator exists in a polymerization member including the step which adds a polymerization initiator in the 1st process of the above, and promotes a polymerization.
[0011] (4) In the manufacture method of the intraocular implant of (1), it is characterized by the state before polymerization reaction is completed being, before the 1st polymerization member's hardening mostly and resulting in contraction process.
[0012] (5) the material for considering as an optical department in the 1st process of the above in the manufacture method of the intraocular implant of (1) -- a cylindrical shape-like polymerization member -- forming -- the 2nd process of the above -- the polymerization of the shape of this cylindrical shape -- it is characterized by arranging the material for considering as a supporter so that the periphery side of a member may be touched

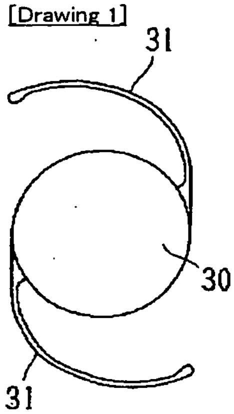
[0013]
[Example] One example of this invention is explained below based on a drawing. Drawing 1 is the plan showing an intraocular implant common 1 piece type. The optical department in which 30 has refractive power, and 31 are the supporters for making the optical department 30 hold within an eye, are formed of material which is different in the optical department 30, and have flexibility.
[0014] Next, an example of the manufacture method of this intraocular implant is explained. First, as shown in drawing 2 (a), the optical faculty material 1 of the liquid for forming the optical department 30 is flowed into the cylindrical shape reaction container 3. An acrylic ester and a methacrylic ester are used as a material of the optical faculty material 1. For example, it is the copolymerization object to which copolymerization of the various stiffness material represented by a polymethylmethacrylate (PMMA) and ethyl methacrylate (EMA), the various hydrophilic flexible material represented by hydroxyethyl methacrylate (HEMA), and the acrylic ester which are such stiffness material and a hydrophilic flexible material further and a methacrylic ester was carried out. If a supple material is used, a foldable soft intraocular implant can be obtained.
[0015] Moreover, you may add the bridge formation material represented by such material at ethylene glycol dimethacrylate (EGDMA).
[0016] In addition, the diameter of the reaction container 3 is the same as the diameter of the optical department of the intraocular implant used as a product at least, or a larger thing than it is used for it.
[0017] Then, little addition of the polymerization initiator 2 for giving the cause of a polymerization start is carried out at the optical faculty material 1 which flowed into the reaction container 3. As a polymerization initiator 2, many things are known conventionally, for example, when it is a heating polymerization, in the case of photopolymerization, an azobisisobutyronitril, azobis dimethylvaleronitrile, etc. can use a benzoin, methyl orthochromatic benzoyl benzoate, etc.
[0018] After adding a polymerization initiator 2, it heats (or optical irradiation) and a polymerization is made to start. Thereby, heat (or light) decomposes and a polymerization initiator 2 comes to produce a radical (free radical). If the polymerization initiator 2 which produced the radical collides with the molecule of the optical faculty material 1, a polymerization initiator 2 and the optical faculty material 1 will join together. The radical which existed in the polymerization initiator 2 serves as a joint factor with the optical faculty material 1, and disappears, instead a radical produces it in the optical faculty material 1. the optics which has a radical after that -- the optics of others [molecule / of a member 1] -- by repeating a collision and combination in the molecule of a member 1, a radical is produced continuously and polymerization hardening advances
[0019] Here, if polymerization time long enough is taken, the generated radical comrade is also combined, polymerization reaction is completed, and the optical faculty material 1 will be in the state where carry out polymerization hardening completely and a radical does not exist.
[0020] then, this invention -- setting -- optics -- before the state, i.e., a polymerization, where many radicals remain in the member 1 is completed completely, it shifts to the following process (supporter material 4 mentioned later optics process which carries out polymerization hardening on the side of a member 1) It is desirable, before the optical faculty material 1 hardens mostly and results in contraction process as this timing. For example, after it has ended at 48 hours and 60 degrees C when using that to which copolymerization of HEMA and the EMA is carried out by the ratio 85:15 as a material of the optical faculty material 1, and it has ended heating in order of 24 hours at 70 degrees C by 50 degrees C for 24 hours, it shifts to the following process.
[0021] If the optical faculty material 1 of the shape of a pillar which carried out polymerization hardening in the state where many radicals remain is obtained, as shown in drawing 2 (b), this is fixed in the center of a simultaneously of the reaction container 5 of a cylindrical shape. The diameter of the reaction container 5 is the same at least compared with the overall length of an intraocular implant, or uses a larger thing than it. If the optical faculty material 1 is fixed, the supporter material 4 used as a supporter 31 will be flowed into the periphery of the optical faculty material 1. An acrylic ester and a methacrylic ester can be used as the material, and they are the upright material represented by PMMA, EMA, etc., the copolymerization object to which copolymerization of what equips such upright material with flexibility, such as 2-ethylhexyl methacrylate, was carried out as the example.
[0022] Heat is applied to the reaction container 5 and a polymerization is made to start after flowing the supporter material 4. Polymerization hardening is performed only by applying heat for polymerization promotion, without using a polymerization initiator by this example on the occasion of the polymerization at this time. As mentioned above, since the polymerization has not ended the optical faculty material 1 completely, it is in the state where many radicals remain in the periphery portion. The molecule of the supporter material 4 which made the molecular motion intense by heating is combined by colliding with the radical of the optical faculty material 1. That is, on the occasion of the polymerization of the supporter material 4, the optical faculty material 1 with a radical achieves the duty of a polymerization initiator, and the polymerization comes to advance from combination of the radical of the periphery portion of the optical faculty material 1, and the supporter material 4. Furthermore, the polymerization advances by the chain reaction depended radically. In this way, the compound member of the supporter material 4 and the previous optical faculty material 1 is formed. Since chain reaction occurs without radical being influenced [which is produced from a polymerization initiator] when the polymerization initiator is not added, the supporter material 4 carries out polymerization hardening, combining with the optical faculty material 1 firmly chemically, and the joint becomes stronger compared with the case where a polymerization initiator is added.
[0023] In addition, although a polymerization initiator shall not be added in the above at the time of polymerization hardening of the supporter material 4 in order to make a bonding strength firmer, you may make it add a polymerization initiator by relation between a bonding strength and manufacture time required for use of an intraocular implant, other polymerization conditions, etc.
[0024] thus, optics -- the composite taken out from the reaction container 5 as shown in drawing 2 (c) when the compound member of a member 1 and the supporter material 4 was obtained -- a member 6 is cut in required thickness then, well-known cutting -- a line -- the intraocular implant which has the optical department 30 and a supporter 31 is manufactured by things
[0025] In this way, as for the obtained intraocular implant, the possibility of the increase of the intensity of the joint of the optical department 30 and a supporter 31 and breakage becomes low.
[0026] the above manufacture method -- optics -- carrying out polymerization hardening of the supporter material 4

previously, although polymerization hardening of the member 1 side was carried out previously — composite — you may make it obtain a member 6 This manufacture method is explained based on drawing 3 .
[0027] The supporter material 14 is flowed into the reaction container 13 which consists of two cylindrical cups in drawing 3 (a). After flowing the supporter material 14, little addition of the polymerization initiator 12 is carried out. After adding a polymerization initiator 12, by performing heating (or optical irradiation), heat (or light) decomposes a polymerization initiator 12, a radical (free radical) is produced, and the radical polymerization of the supporter material 14 is performed.
[0028] Before the polymerization reaction of the supporter material 14 is completed completely, it shifts to the following process in the state to which many radicals exist in the supporter material 14 where it solidified.
[0029] In drawing 3 (b), the supporter material 14 of the shape of a cylinder formed by drawing 3 (a) is fixed, and the optical faculty material 11 is flowed into the centrum of the supporter material 14. After flowing the optical faculty material 11, if heat is applied, a polymerization will begin. At this time, it heats without adding a polymerization initiator and a polymerization is performed (a polymerization initiator is added when shortening polymerization time, securing a required bonding strength). Since many radicals remain in the inner circumference portion of the supporter material 14, the molecule of the supporter material 14 and the molecule of the optical faculty material 11 come to join together by the radical. Furthermore, by chain reaction, a polymerization advances and the bonding strength for a joint will become firm.
[0030] in this way, the supporter material 14 and optics — the composite which the member 11 joined and hardened — cutting is performed and an intraocular implant is manufactured, after cutting in required thickness like the above-mentioned, if a member 16 is obtained
[0031] this invention is not limited to what was mentioned above, and various changes are possible for it and it is included by this invention in the range which makes technical thought the same.
[0032]
[Effect of the Invention] As mentioned above, according to this invention, a firm bonding strength is obtained by part for the joint of an optical department and a supporter, and the possibility of breakage can be reduced further.

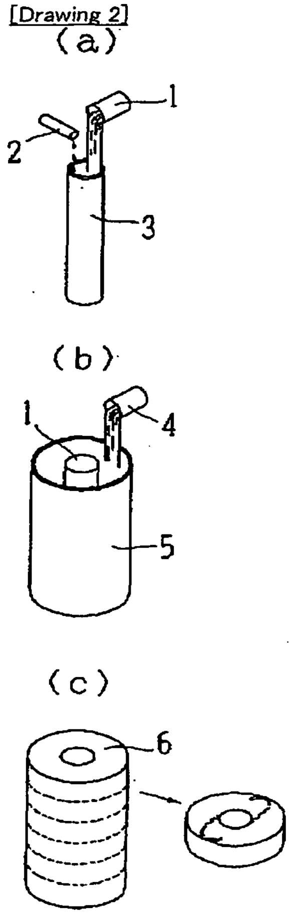
[Translation done.]

DRAWINGS

[Drawing 1]

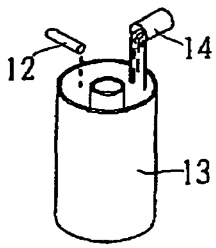


[Drawing 2]



[Drawing 3]

(a)



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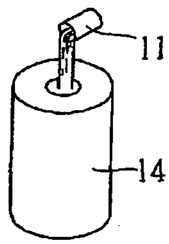

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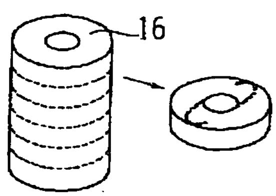

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